THE RELATIONSHIPS BETWEEN DINOSAURS AND BIRDS.

PROF. B. VETTER[1] has recently published a striking article upon this question, which offers strong evidence that the view so long held of the descent of birds from dinosaurian reptiles must be abandoned. The author gives several pages to a *résumé* of the more or less discordant opinions of previous writers; but these lack of space forbids us to notice, as Dr. Vetter's own views must claim our attention.

The oldest known dinosaurs occur in the trias, and are representatives of the Theropoda and Sauropoda, — the former typical carnivores, walking entirely upon the three-toed hind-feet; the latter herbivorous, little differentiated, having the fore and hind limbs plantigrade, pentadactyl, and of nearly equal length. From this it appears that the earliest members of the dinosaur line existed long before the trias, and must have been quadrupeds, with skull, limbs, and pelvis approximating the lizard type. Of the mesozoic dinosaurs, we know at least five or six divergent lines which show more or less likeness to birds in the pelvis and hind-limbs. These do not form a single connected series gradually leading to the birds, but rather a number of divergent series. Let us examine some of these groups.

Stegosauria show many bird-like features of the pelvis and hind-limb, but in every other respect are very different from birds, having a lacertilian skull, an immense tail, and grasping fore-limbs. They are too specialized to be bird ancestors. The Ornithopoda have, with Compsognathus, usually been regarded as forerunners of the birds. Iguanodon will serve as a type of the group. It walked on its elongated hind-legs. The jaw was toothless in front, and very probably had a horny beak. The pelvis is very like that of a Ratite, though with large reptilian pubes; the femur has a third trochanter; and the tibia is as long as the femur. The foot corresponds very closely to the embryonic condition of the bird's foot. The specializations of Iguanodon, however, will not allow us to regard it as a bird ancestor. These are, the entire configuration of the skull, the peculiar tail, the absence of clavicles, the dermal armor, the structure of the fore-limb (which is much shortened). The first finger possesses a dagger-like weapon; the second, third, and fourth, hoof-like, ungual phalanges; and the fifth, which diverges strongly from the others, a claw. May we not, however, imagine a more generalized form as the common ancestor of both Iguanodon and the birds? But it was merely the specializations of Iguanodon that suggested it as a bird ancestor. If we remove these, the simpler sauropodan or even lizard characters appear. Here, at least, we must not speak of homologies with the bird foot and pelvis, but only of analogies. This does not render the facts uninteresting, as they prove anew, how, by the steady operation of the same needs, nearly the same result may be produced from similar raw material, be the remaining structures never so different. For similar reasons Dr. Vetter rejects Coelurus and Hallopus from the category of possible bird ancestors.

In Compsognathus the hind-limb is remarkably bird-like, in the following respects more so than in the Ornithopoda: femur considerably shorter than tibia; distal end of fibula a mere style; astragalus anchylosed with tibia, calcaneum with fibula; tarsus, metatarsals, and phalanges exceedingly similar to those of embryo birds; (in almost all these respects Archaeopteryx comes nearer the modern bird-type, without quite reaching it.) On the other hand, Compsognathus possessed a long ischiadic symphysis, very probably long pubes, greatly shortened fore-limb, the hand clawed and three-fingered, non-pneumatic bones, a lacertilian skull, long neck and tail. Such an animal may represent a further developed side-branch of the Ornithopoda, but was already spoiled as a flyer. Dr. Vetter rejects the opinion that Compsognathus could have been an ancestor of the Ratitae, as he derives both classes of birds from a common form. The result, then, of this investigation, agrees quite closely with that of Seeley and Vogt, that there is no direct connection between dinosaurs and Carinatae at least, and probably none with the Ratitae. If, as seems in every way probable, the Carinatae and Ratitae are descended from a common ancestor, the latter cannot be derived from the dinosaurs.

[1] Festschrift der naturwiss. gesellsch. 'Isis' in Dresden, Mai, 1885. pp. 109-122.

PHOSPHORESCENCE OF MARINE ANIMALS.

EHRENBERG, in his 'Das leuchten des meeres,' published in 1835, quotes four hundred and thirty-six authors who had written upon this subject up to that time; and very many additional observations have been since recorded. The property of phosphorescence is common to certain members of the Protozoa, and to the coelenterates, echinoderms, worms, rotifers, crustaceans, molluscoids, mollusks, and fishes, among the Metozoa. Fully three-fourths of Professor McIntosh's interesting address was devoted to a review of the phosphorescent forms belonging to these several groups; their distribution, and the appearance, intensity, and character of the luminosity being described in some detail. We limit ourselves to a short abstract of the concluding portion of his remarks.

As regards the causes of phosphorescence, Professor McIntosh said, "I do not deem it necessary to go into detail with regard to the numerous views which have been advanced to account for the phosphorescence of marine organisms, for these range over a very wide area, — from its production by electricity, by the constant agitation of the water, by putrefaction, by luminous imbibition, to its manifestation as a vital action in the animals, or a secretion of a phosphorescent substance. . . .

"It will be observed that in the Protozoa, the structure of the minute but often very abundant animals,

Abstract of the opening address before the section of biology of the British association for the advancement of science, by Prof. W. C. MCINTOSH, president of the section. From advance sheets of *Nature*.

which furnish the luminosity, clearly proves that the presence of a well-defined nervous system is not required for its manifestation, the protoplasm of their bodies alone sufficing for its development. There are no glands for secreting it, and, in some, apparently no fatty matter for slow combustion. In the coelenterates the phenomena appear to be more nearly related to nervous manifestations, though in certain cases the luminous matter possesses inherent properties of its own. While in certain annelids, again, such as Chaetopterus and Polycirrus, there are glands which may be charged with the secretion of a luminous substance, it is otherwise with certain Polynoidae, in which the emission of light appears to be an inherent property of the nervous system. The irritability in the phosphorescent examples of the latter family, however, varies considerably, some, e.g., Polynoe scolopendrina, being sluggish, while others, like Harmothoe, are extremely irritable. In the crustaceans the luminosity seems to have the nature of a secretion, probably under the control of the nervous system. In Pyrosoma and Pholas dactylus a luminous secretion is also a prominent feature; and in both the latter and the annelids, decay excites its appearance, as also is the case, to a limited extent, in fishes.

"It is evident, therefore, that the causation of phosphorescence is complex. In the one group of animals it is due to the production of a substance which can be left behind as a luminous trail. The ease, for instance, with which, in Pennatula and other coelenterates, the phosphorescence can be repeatedly produced by friction on a surface having a minute trace of the material, clearly points to other causes than nervous agency. The action, moreover, clearly affects the organic chemical affinities of the tissues engaged. On the other hand, again, as in certain annelids, it is purely a nervous action, probably resembling that which gives rise to heat."

Many of the older authors connected the emission of light with the economy of the deep sea: the same notion was brought forward in the 'Report of the cruise of the Porcupine,' 1870; and some naturalists still appear to hold a similar view. After stating the supposed benefits to be derived from the possession of this property by deep-sea forms, Professor McIntosh suggested that much caution is necessary in theorizing in this direction, explaining that, "In the first place, phosphorescent animals do not appear to be more abundant in the depths of the sea than between tide-marks, or on the surface, the latter, perhaps, presenting the maximum development of those exhibiting this phenomenon. Very many of the young that have been indicated as so brilliantly luminous become surface-forms soon after leaving the egg, and thus, at their several stages, more or less affect the three regions, — of surface, midwater, and bottom."

"A survey of the life-histories of the several phosphorescent groups affords at present no reliable data for the foundation of a theory as to the functions of luminosity." The irregularity of its occurrence in animals possessing the same structure and habits, the fact that the possessors of phosphorescence among annelids are often the inhabitants of tubes, or are commensalistic on star-fishes, in brief, the great variety of condition accompanying its presence in the different groups, necessitates the greatest caution in making deductions, especially if they are to have a wide application.

THE LEAVES OF THE PITCHER-PLANT.

THE *American naturalist* for June contains an interesting article by Joseph F. James, upon the evolution of the leaves of the pitcher-plant. He considers that the ancestral form belonged to the lily family, and that its home was South America, from which, in later times, it spread and modified itself in North America. He supposes that water, lodging on the upper surfaces of some leaves, was retained there; and that in this water insects were caught and drowned. Their decay might have produced a manure which assisted the plant in its growth; and the plant, finding it advantageous to have a cup-like leaf, would then, in a few generations, have developed just such a leaf as was needed. After a while, boggy land would be found better adapted for its existence, and the pitcher-plant family would be well started.

The primitive form is now lost; and the most rudimentary species is the Venezuelan genus, Heliamphora (fig. 1), which is simply a hollow tube, with a narrow opening one-fourth the way to the bottom, and with a small rudimentary hood at the top. Nearly the whole interior of the leaf is lined with hairs, those at the bottom long and slender, and those at the top short and thick. They do not seem to be either secreting or absorbing hairs, but serve simply to prevent the escape of insects. The next advance is in our Sarracenia purpurea, so common in the eastern and northern United States. In this species, there is a more perfect tube, open only at the top, and surmounted on one side by an upright hood (fig. 2), the inner surface of which is thickly covered with short,

FIG. 1.

FIG. 2.